Amphibians and Reptiles of Monts Doudou, Gabon: Species Turnover Along an Elevational Gradient

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A 28-day-long herpetofaunal survey was conducted in the Monts Doudou-Moukalaba reserve complex in southwestern Gabon during February/March 2000. Methods included 22 days (or 726 trap-days) using pitfall traps in combination with drift fences set at three elevational zones. The main objectives were to determine the species richness of this region and to study partitioning of the various species along an elevational gradient, i.e., between 100 and 660 m.

A total of 78 species comprising 54 amphibians and 24 reptiles were recorded during this survey, and another eight reptile species were recorded subsequently. The real reptile richness of Monts Doudou is believed to be much higher than the current total of 32 species. In contrast, the 54 amphibian species constitutes a relatively high richness for a single locality, especially considering that 72 species are known from the whole of Gabon (Blanc and Frétey 2000b; Frétey and Blanc 2000). Six of the Monts Doudou amphibian species, including the genera *Hemisus* and *Kassina*, were new for Gabon.

Comparisons of amphibian species turnover along the elevational gradient revealed only moderate evidence of altitudinal effects. Increased surveying efforts in this region would most likely disprove some of the current recorded species composition differences. A subset of our results showed greater variation between sites at the same elevation, thus suggesting that the effects of ecotones in a heterogeneous forest habitat may be more influential as a determinant of amphibian communities.

Alpha-level taxonomy of African amphibians and reptiles is generally still rudimentary and most of the central African countries have been neglected in this regard. It is imperative that countries like Gabon develop local expertise to address these herpetological shortfalls.

Résumé

Un inventaire herpétofaunal de 28 jours a été conduit au complexe de réserve de Mont Doudou-Moukalaba au Sud-Ouest du Gabon, pendant février-mars 2000. Les trous-pièges combinés avec les haies de conduite en plastique ont été laissées sur trois zones d'élévation pendant 22 jours, soit pendant un total de 726 nuits-pièges. Les objectifs principaux de l'étude étaient de déterminer la richesse spécifique de l'herpétofaune de cette région et de voir la répartition de ces espèces le long du gradient d'élévation entre 100 et 660m.

Un total de 78 espèces comprenant 54 amphibiens et 24 reptiles ont été recueillies pendant l'inventaire et 8 autres espèces de reptiles ont été trouvées ultérieurement. La richesse réelle en reptiles de la région est considérée plus élevée que l'actuel total de 32 espèces. Cependant, la richesse de 54 espèces d'amphibiens est relativement élevée pour une seule localité si on considère qu'un total de 72 espèces sont connues dans tout le Gabon (Blanc et Frétey 2000b, Frétey et Blanc 2000). Six des espèces d'amphibiens récoltées au Mont Doudou, y compris les genres *Hemisus* et *Kassina*, sont nouvelles pour le Gabon.

Les comparaisons des successions d'espèces d'amphibiens le long du gradient d'élévation révèlent une évidence modérée des effets de l'altitude. L'accroissement d'effort de capture dans cette région refutera les quelques différences enregistrées quant à la composition en espèces pour chaque élévation.

Une partie de nos résultats a montré une variation plus élevée entre les sites de même élévation, suggérant ainsi que les effets des écotones dans les forêts hétérogènes pouvaient être plus influents pour la détermination des communautés d'amphibiens. L'alpha-taxonomie des reptiles et amphibiens africains est encore généralement rudimentaire et beaucoup de pays africains ont été négligés de ce point de vue. Il est impératif que ces pays, tels que le Gabon, développent une expertise locale pour surmonter ces retards herpétologiques.

> *One of the clear things about the African amphibian fauna is that we still know very little about it.*
>
> – Poynton (1996)

Introduction

Herpetofaunal surveys of central African countries have generally been conducted in a nonsystematic fashion with some countries being very well studied and others almost completely ignored to date. The recent syntheses by Frétey and Blanc (2000) presented amphibian species checklists for Cameroon, Central African Republic, Equatorial Guinea, Gabon, Congo, the Democratic Republic of Congo (DRC), and the oceanic islands off Gabon and Equatorial Guinea. The total of 72 species for Gabon is not very high when compared with neighboring countries such as the DRC (216) and Cameroon (194). The relatively low amphibian species richness in Gabon may be related to its smaller size (i.e., 268,031 km^2 versus DRC 2,344,113 km^2 and Cameroon 475,500 km^2) and less diversity of habitat and altitude, but it may also be a result of insufficient field surveys conducted here. The reptile fauna of Gabon has never been subjected to a comprehensive regional synthesis and species richness figures are thus not readily available. However, the situation is likely to be similar to the amphibian fauna, i.e., under represented due to a paucity of inventorial studies.

The first notable reports on amphibians and reptiles from this region were compiled by Duméril (1856), Hallowell (1857), Günther (1896), Boulenger (1899, 1900) and Mocquard (1897a, b; 1902). Louis-Philippe Knoepffler's herpetological works in Gabon were varied and included some localized and regional faunal assessments (Knoepffler 1966a, 1967a, 1968, 1974, 1979), taxonomy (Knoepffler 1967b, 1967c), ecology (Knoepffler 1965, 1966b, 1967d, 1976) and parasitology (Euzet et al. 1966, Combes and Knoepffler 1967, Maeder et al. 1969, Dupouy and Knoepffler 1978). Recent publications dealing with herpetofaunal surveys in Gabon are by Toft (1982), Waardenburg and Guicherit (1991), Blanc (1998), Frétey and Blanc (2001), Frétey and Dewynter (1998), Blanc and Frétey (2000a), Lötters et al. (2000), Lötters et al. (2001), Gossman et al. (2002) and Pauwels et al. (2002a, b). Some recent taxonomic treatments and species descriptions which include Gabon fauna are by Ohler and Kazadi (1990), Ohler (1996, 1999), Amiet (2000), Bour (2000), and Bauer and Pauwels (2002). Gramentz (1998a, 1998b, 1999a, 1999b, 1999c, 2001) has published on the morphological variation, ecology, and conservation of various Gabon reptile species. Important marine turtle breeding sites along the Gabon coast have been recognized, e.g., Fretey (1998) and Billes (2000).

This paper reports on the herpetological results of a multi-disciplinary biological inventory that was conducted in the Monts Doudou-Moukalaba reserve complex in southwestern Gabon during February/March 2000. The main objectives were to determine the species richness of this region and to study partitioning of the various species along an elevational gradient, i.e., between 100 and 660 meters above sea level. As far as we are aware, no herpetological studies had previously been reported for this region.

Description of Study Area

The Monts Doudou-Moukalaba reserve complex is part of a series of eight protected areas in the Gamba region, Province Ogoué-Maritime, southwestern Gabon. These protected areas are situated in the biologically diverse Atlantic Equatorial Forest ecoregion, which represents a transition between the tropical forest zones and the savanna ecosystems of the south. More specific details on the region's geographical location, climate, geomorphology and geology, soils, hydrology and meteorology are presented by Thibault et al. (this volume).

The main focus of our fieldwork was at three camps along an elevational gradient. These were Camp 1 (site 6) at 110 m, Camp 2 (site 8) at 350–425 m and Camp 3 (site 9) at 585–660 m. Fieldwork was also conducted at a few nearby localities. Geographical and habitat details of the ten study sites follow:

1. Doussala village and immediate surroundings. Habitat is open savanna with small marshes: Reserve de Faune de la Moukalaba-Dougoua, 02°20.16′S, 10°35.47′E, alt. 100 m. Survey effort at this locality was opportunistic searching during one afternoon and one night.

2. Forest habitat with a small stream: Reserve de Faune de la Moukalaba-Dougoua, 10.8 km 214° SW of Doussala, 02°25.36′S, 10°32.72′E, alt. 110 m. Survey effort at this locality was opportunistic searching for only two hours during late morning.

3. Series of swamps in forest habitat near the forest/savanna ecotone: Reserve de Faune de la Moukalaba-Dougoua, ± 5 km NW of Doussala, 02°19.24′S, 10°32.16′E, alt. 110 m. Survey effort at this locality was opportunistic searching for about 12 hours during two nights.

4. Forest habitat south of Camp 1: Reserve de Faune de la Moukalaba-Dougoua, 9–11 km 305° NW of Doussala, 02°17′S, 10°29′E, alt. 110 m. Survey effort at this locality formed part of that of Camp 1.

5. Université de Rennes Camp: Reserve de Faune de la Moukalaba-Dougoua, ± 11 km 305° NW of Doussala, 02°17′S, 10°29′E, alt. 110 m. Survey effort at this locality was haphazard over a period of 26 days and included pitfall trapping.

6. Camp 1. Forest habitat with small river: Reserve de Faune de la Moukalaba-Dougoua, 12.5 km 305° NW of Doussala, 02°17.00′S, 10°29.83′E, alt. 110 m. Survey effort at this locality was opportunistic searching during 11 days, including eight days of pitfall trapping, i.e., 88 trap-days.

7. Forest habitat north of Camp 1: Aire d'Exploitation Rationnelle de Faune des Monts Doudou, 13–15 km NW of Doussala, 02°15′S, 10°29′E, alt. ± 110 m. Survey effort at this locality formed part of that of Camp 1.

8. Camp 2. Forest habitat with small river: Aire d'Exploitation Rationnelle de Faune des Monts Doudou, 24.3 km 307° NW of Doussala, 02°13.35′S, 10°24.00′E, alt. 350–425 m. Survey effort at this locality was opportunistic searching during 8 days, including seven days of pitfall trapping, i.e., 77 trap-days.

9. Camp 3. Forest habitat on mountain peak. Start of mountain streams: Aire d'Exploitation Rationnelle de Faune des Monts Doudou, 25.2 km 304° NW of Doussala, 02°13.63′S, 10°23.67′E, alt. 585–660 m. Survey effort at this locality was opportunistic searching during 8 days, including seven days of pitfall trapping, i.e., 77 trap-days.

10. No precise collecting information. Locality data entered in museum registers as: Reserve de Faune de la Moukalaba-Dougoua, NW of Doussala, 0210AD. A batch of reptile and amphibian specimens that were collected by Violaine Nicolas between March and October 2000.

Materials and Methods

Three different camp sites, each located at a different altitude (110 m, 350–425 m and 585–660 m), were surveyed during February/March 2000. The basic approach to surveying reptile and amphibian communities along an elevational gradient follows that of similar studies conducted in Madagascar in recent years (e.g., Raxworthy and Nussbaum 1996; Raxworthy et al. 1998; Nussbaum et al. 1999).

Arrays of pitfall traps in combination with drift fences were erected as a passive capturing technique, which enabled quantitative comparisons to be made between the three different camp sites. Three trap lines were set in three different microhabitat types (e.g., in a valley bottom, on a slope, and along the crest of a ridge) at each camp. The only exception was at Camp 1, which had little topographical variation. Here we set two lines in the forest and one along a river margin. In addition to amphibians and reptiles, these traps were also capturing small mammals and arthropods.

A trap line consists of a 100-meter strip of plastic sheeting (drift fence) with sunken plastic buckets (pitfall traps) at 10 m intervals. Drift fences (0.5 m high) were stapled vertically onto wooden stakes. An apron left at the base was covered with soil and leaf litter to encourage individuals to move along the fence (towards the pitfalls) instead of trying to pass beneath it. The pitfall traps (275 mm deep, 285 mm top internal diameter, 220 mm bottom internal diameter) were sunk with their rims flush with ground level and positioned so that the drift fences ran across the middle of each trap. One pitfall trap was set at each

end of a drift fence with another nine traps spaced in between. Small holes (3–5 mm diameter) were burned in the base of buckets to allow for water drainage after rainfall events. Pitfall trap lines were set for eight days at Camp 1 and for seven days each at Camps 2 and 3 (see Table 1). The trap lines were checked each morning to collect amphibians and reptiles that may have fallen in during the night. Steve Goodman checked the lines again in the afternoons, but 99% of these times the traps contained no herpetological specimens. A trap-day is defined as one bucket in use for a 24-hour period. The daily capture rates of each trap line at each camp were calculated by dividing the total number of specimens collected during a trapping period by the number of trap-days (see Table 1). This formula for calculating daily capture rates followed the example of similar herpetofaunal and small mammal surveys (e.g., Raxworthy and Nussbaum 1996; Raxworthy et al. 1998; Nussbaum et al. 1999; Goodman and Hutterer, this volume). For comparisons of faunal uniqueness of the various sites, the species total of a particular site over the number of unique species for that site was calculated as a percentage. Coefficients of community (similarity indices) were determined as the number of shared species divided by the total number of species of the two localities being compared.

Active searches for specimens during day and night were made to supplement the pitfall efforts. Search techniques employed included visual scanning of terrain (using flashlight by night), refuge examination (e.g., lifting rocks and logs, peeling away bark, scraping through leaf litter) and tracking frog choruses. The bulk of the opportunistic sampling was conducted by Marius Burger, but additional specimens were also occasionally captured by other members of the biological inventory team: Patrice Christy, Brian Fisher, Steve Goodman and Simon van Noort.

At the time of our survey, a small mammal study incorporating the use of drift fences with pitfall traps was also being conducted by Station Biologique de Paimpont, Université de Rennes at site 5. This provided an opportunity to obtain further herpetological material from the region and Violaine Nicolas agreed to preserve samples of select individuals collected at this site (25 February to 21 March 2000). Although site 5 was located less than 1 km from Camp 1, the data obtained from there were not included in the species comparisons between Camps 1 to 3 since this would introduce an effort bias in the elevational species comparisons. Similarly, additional material subsequently collected by Nicolas between March and October 2000 (site 10) was not included. Although these have no precise collecting information, the data were added to the Monts Doudou herpetofaunal checklist.

Live specimens of most amphibian and reptile species collected during the survey were photographed to record color and patterning. These photographic slides are kept in M. Burger's private collection. Tape recordings of frog calls were collected for 23 species using a Sony TC-D5 PRO stereo cassette recorder. Individual calls were analyzed using Canary 1.2.4 and Sound Edit.

Representative voucher specimens were killed by placing tissue paper soaked with technical ether in an airtight plastic container with the animals. Chelonians and large snakes were killed by euthanasia injection. Specimens were fixed in a 10% formalin solution and were later transferred to alcohol for long-term storage. Liver and muscle tissue samples of almost all of the taxa collected were preserved in 95% ethanol for DNA analyses. Series of amphibian voucher specimens were deposited at the South African Museum (SAM) and reptiles in the Port Elizabeth Museum (PEM). These represent 257 (and 14 tadpoles) and 69 specimens respectively, and form the basis of the material discussed in this report. Duplicate material (ca. 200 specimens) will be deposited at a relevant institution in Gabon and at the California Academy of Sciences (CAS) and the Field Museum of Natural

History, Chicago (FMNH). On two occasions in this paper we make reference to material in the FMNH and once to a specimen in the Museum National d'Histoire Naturelle, Paris (MNHN).

The various families, subfamilies, genera, and species in the species accounts are presented alphabetically and do not reflect a phylogenetic arrangement. The nomenclature for many amphibian and reptile groups is still in a state of flux and consensus has not yet been reached between various workers. We generally follow Frost (2000) in respect to amphibian classification at the family, subfamily and genus levels, exceptions being our usage of *Xenopus* over *Silurana* (see Kobel et al. 1996) and *Amnirana* over *Rana* (see Dubois 1992). In the case of the reptiles we follow Broadley's (1998a) reptile checklist of the Democratic Republic of the Congo.

Identifications of amphibian species were based on descriptions in literature (Perret 1966, 1977, 1984; Lamotte 1967; Lamotte and Perret 1968; Laurent 1972; Amiet 1972, 1977, 1991, 2000; Schiøtz 1999) and comparisons of published sonograms (Tandy and Drewes 1985; Schiøtz 1999; Bosch et al. 2000; Márquez et al. 2000; Rödel 2000; De la Riva et al. 2001). Not all material was identified to the species level. This does not necessarily imply that such specimens represent undescribed taxa, although we believe that it does in some cases. Species identification in the genera *Hyperolius* and *Phrynobatrachus* is notoriously difficult because of the large numbers of valid species and synonyms that have been described (Poynton 1999; Frost 2000). Reptiles were identified from the literature, e.g., Loveridge 1939, 1947, 1958; Laurent 1950; Tys van den Audenaerde 1967; Brygoo and Roux-Esteve 1983; Rasmussen 1989; Lawson and Ustach 2000; Chippaux 2001.

This paper is primarily concerned with the species richness and variation in elevational distribution of amphibians and reptiles at Monts Doudou. For amphibians the details on species morphometrics, call structures, and descriptions of new taxa will be presented in forthcoming publications. For the reptile material we present details on scutelation, reproductive condition, hemipenal morphology, stomach contents and body proportions. Total lengths of specimens are presented as head-and-body length + tail length. Abbreviations used are SVL for measurement of snout vent length (same as head-and-body length) and TL for total length. MSR is midbody scale row count.

Results

Summaries of the amphibian and reptile species recorded during the study are presented in Tables 1 and 2, respectively. The total numbers of species recorded from all ten sites are 54 amphibians and 32 reptiles. Of these, 34 amphibian and 17 reptile species were recorded from the elevational transect comprised of camps 1, 2, and 3.

A total of 726 pitfall trap-days yielded 263 amphibian captures and a daily capture rate of 36% (Table 3). The capture rate of amphibians decreased sharply from the lowest elevation up to the highest, with overall rates of 74.6% (197 specimens), 20.4% (47 specimens), and 8.2% (19 specimens) at camps 1, 2, and 3 respectively.

Seven species were collected in pitfall traps, 73% of which were of two species, i.e., *Xenopus epitropicalis* (138 specimens) and *Hemisus perreti* (53 specimens). High numbers of these two species were present in the traps following nights with good rainfall. *Hemisus perreti* was the only species not encountered during opportunistic sampling and the pitfall traps were thus important in recording the occurrence of this species. Likewise, more than 95% of *Xenopus epitropicalis* and about 90% of *Geotrypetes seraphini* specimens were from pitfall captures. Only one reptile, the Serrated Hinged Tortoise (*Kinixys erosa*), was

sampled by the pitfall traps, whereas the pitfall line set at the Université de Rennes camp (site 5) collected three skink species, i.e., *Mabuya affinis*, *M. polytropis* and *Leptosiaphos breviceps*. These species were also encountered during opportunistic searches and thus the pitfall traps were ineffective in boosting the total reptile species richness during this survey.

The amphibian species accumulation curves, incorporating the results of all sampling techniques, are presented in Figure 1. The cumulative species totals for Camps 1 and 2 were still increasing on the second to last and last day respectively, whereas no new species were added during the last three days at Camp 3.

The amphibian species richness figures recorded for the three camps are 21, 22, and 17 respectively, and comprise 34 species in total (Table 4). Of these, eight species were unique to Camp 1, six to Camp 2, and two to Camp 3 (see Table 4 and Figure 2). Camps 1 and 2 combined had 32 species, whereas Camps 2 and 3 totaled 26 species. Camp 1 shared 11 species with Camp 2 and 10 species with Camp 3. Camp 2 shared 13 species with Camp 3 and eight species were shared between all three camps.

Of the 53 frog species noted during this survey, 29 were observed calling and 22 of these were recorded on tape (see Table 1). In addition, a number of unidentified frog calls were noted at various localities. Some of these may belong to the 23 species for which no direct call observations were made, and/or they may belong to species that were not recorded during the survey.

TABLE 1. Checklist of amphibians (in alphabetical order) recorded from ten different localities at the Monts Doudou reserve comoplex. M - Museum specimen, T - Tape recording, H - Heard call (not taped), S - sight record.

Species	Localities									
	1	2	3	4	5	6	7	8	9	10
CAECILIANS										
Geotrypetes seraphini					M	M		M	M	
FROGS										
Acanthixalus spinosus		M								
Afrixalus fulvovittatus	MH									
Afrixalus sp. 1			MH							
Alexteroon obstetricans						M				
Amnirana amnicola								MT	M	
Amnirana lepus								M		
Arthroleptis variabilis					M				M	
Astylosternus batesi									MT	
Bufo camerunensis					M	M		M	M	
Bufo gracilipes					M					
Bufo maculates	MH									
Bufo tuberosus								M		
Cardioglossa gracilis					M	MT		M	T	
Cardioglossa leucomystax						MT		MT		
Cardioglossa sp. 1								MT	MH	
Chiromantis rufescens								MH		

TABLE 1. continued.

Species	Localities									
	1	2	3	4	5	6	7	8	9	10
Conraua crassipes						M	M	M	MH	
Dimorphognathus africanus						MH		MT	MT	
Hemisus perreti					M	M				
Hoplobatrachus occipitalis	M									
Hyperolius cinnamomeoventris	M		MT							
Hyperolius guttulatus			MT							
Hyperolius nasutus	M		MT							
Hyperolius ocellatus						MT		MT	MT	
Hyperolius tuberculatus			MT							
Hyperolius sp. 1			MT							
Hyperolius sp. 2			MT							
Hyperolius sp. 3			M							
Kassina sp. 1			T		M	M				
Leptopelis aubryi	MH									
Leptopelis calcaratus						MT			MH	
Leptopelis ocellatus								MT	MT	
Leptopelis millsoni						MT				
Leptopelis rufus								M		
Leptopelis sp. 1										M
Nectophryne batesii								M		
Petropedetes sp. 1								M	M	
Phlyctimantis leonardi			T							
Phrynobatrachus auritus					M	M				
Phrynobatrachus cornutus						M			M	
Phrynobatrachus sp. 1				M						
Phrynobatrachus sp. 2								T	MT	
Phrynobatrachus sp. 3			M							
Ptychadena aequiplicata					M					
Ptychadena perreti				S			M			
Ptychadena pumilio			MT							
Schoutedenella poecilonota					M	M		H	MT	
Schoutedenella sylvatica					M	MH		H	MT	
Scotobleps gabonicus								MH		
Trichobatrachus robustus								M		
Xenopus epitropicalis					M	M		M		
Xenopus fraseri							M			

TABLE 2. Checklist of reptiles recorded from ten different localities at the Monts Doudou reserve complex. M - Museum specimen, S - Sight record.

Species	Localities									
	1	2	3	4	5	6	7	8	9	10
LIZARDS										
Feylinia grandisquamis						M		M		M
Gerrhosaurus nigrolineatus	S									
Hemidactylus fasciatus					M	M		M	M	
Hemidactylus muriceus					M	M				
Hemidactylus cf. mabouia	S									
Leptosiaphos breviceps					M			M		M
Mabuya affinis				M	M		M			
Mabuya albilabris										M
Mabuya polytropis				M	M			M		
Rampholeon spectrum								M	M	
SNAKES										
Atheris squamigera								M		
Atractaspis corpulenta					M					M
Bitis gabonica										M
Boiga pulverulenta						M				
Bothropthalmus lineatus										M
Causus lichtensteini										M
Calabaria reinhardtii									M	
Crotaphopeltis hotamboeia							M			M
Dendroaspis jamesonii							S			
Dipsadoboa duchesnii			M						M	
Dipsadoboa weileri										M
Grayia ornata										M
Hapsidophrys smaragdina					M					
Mehelya capensis savorgnani										M
Mehelya guirali					M					
Naja melanoleuca						S?				M
Natriciteres fuliginoides								M		M
Philothamnus carinatus										M
Philothamnus sp. 1 *							M			
Rhamnophis aethiopissa										M
CROCODILIANS										
Crocodylus cataphractus			S							
CHELONIANS										
Kinixys erosa					M			M	S	
Pelusios castaneus	M									

* *Philothamnus* sp. 1 may be the same species as, or different from, *P. carinatus*. It was not included in the species richness tally.

TABLE 3. Details of trap line positions, trap dates, and capture results of amphibians and reptiles at Camps 1,2, and 3 of the Monts Doudou-Moukalaba reserve complex.

	CAMP 1			CAMP 2			CAMP 3		
Trap lines	1	2	3	4	5	6	7	8	9
Altitude (m)	110			350–425			585–660		
First trap-day	24 February 2000			05 March 2000			14 March 2000		
Last trap-day	02 March 2000			11 March 2000			20 March 2000		
Total trap-days	88	88	88	77	77	77	77	77	77
					S				
AMPHIBIA									
Unidentified juvenile Arthroleptidae *	–	5	9	–	4	8	1	–	2
Bufo camerunensis	1	1	1	6	6	3	3	3	5
Geotrypetes seraphini	–	1	–	1	1	–	1	2	1
Hemisus perreti	5	30	18	–	–	–	–	–	–
Kassina sp. 1	1	–	1	–	–	–	–	–	–
Schoutedenella sylvatica	2	–	2	–	–	–	–	1	–
Xenopus epitropicalis	43	58	19	11	2	5	–	–	–
Total number of amphibian captures	52	95	50	18	13	16	5	6	8
Daily capture rate for amphibians	59.1%	108.0%	56.8%	23.4%	16.9%	20.8%	6.5%	7.8%	10.4%
Overall capture rate for amphibians		74.6%			20.4%			8.2%	
REPTILIA									
Kinixys erosa	–	–	–	1	–	2	–	–	–

* Unidentified juvenile Arthroleptidae specimens are presumed to include *Schoutedenella poecilinotus* and *S. sylvatica*.

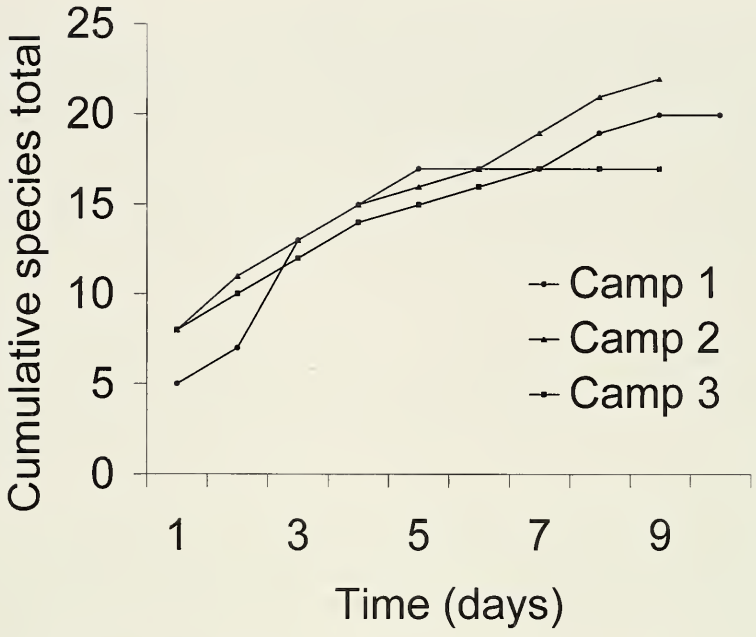

FIGURE 1. Species accumulation curves.

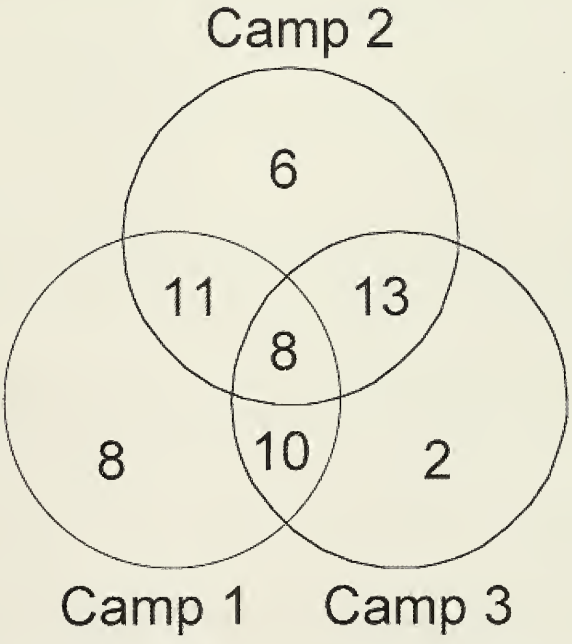

FIGURE 2. Graphic presentation of amphibian species richnes, turnover, similarity, and uniqueness between Camps 1, 2, and 3 of the Monts Doudou-Moukalaba reserve complex.

TABLE 4. Details of amphibian species turnover between Camps 1, 2, and 3. The first column lists the cumulative 34 species recorded from all three camps. The next three columns reflect species occurrence at these camps, followed by species uniqueness (U) at each camp and species shared (=) between camps. The last two columns show combined (+) species richness of Camps 1 and 2, and Camps 2 and 3 respectively. Note that Camp 1 consists of study sites 4, 6, and 7; Camp 2 is site 8 and Camp 3 is site 9.

Species - Amphibia	1	2	3	U1	U2	U3	1=2	1=3	2=3	1=2=3	1+2	2+3
Alexteroon obstetricans	1			1							1	
Amnirana amnicola		1	1						1		1	1
Amnirana lepus		1			1						1	1
Arthroleptis variabilis			1			1						1
Astylosternus batesi			1			1						1
Bufo camerunensis	1	1	1				1	1	1	1	1	1
Bufo tuberosus		1			1						1	1
Cardioglossa gracilis	1	1	1				1	1	1	1	1	1
Cardioglossa leucomystax	1	1					1				1	1
Cardioglossa sp. 1		1	1						1		1	1
Chiromantis rufescens		1			1						1	1
Conraua crassipes	1	1	1				1	1	1	1	1	1
Dimorphognathus africanus	1	1	1				1	1	1	1	1	1
Geotrypetes seraphini	1	1	1				1	1	1	1	1	1
Hemisus perreti	1			1							1	
Hyperolius ocellatus	1	1	1				1	1	1	1	1	1
Kassina sp.	1			1							1	
Leptopelis calcaratus	1		1					1			1	1
Leptopelis ocellatus		1	1						1		1	1
Leptopelis rufus		1			1						1	1
Leptopelis millsoni	1			1							1	
Nectophryne batesii		1			1						1	1
Petropedetes johnstoni		1	1						1		1	1
Phrynobatrachus auritus	1			1							1	
Phrynobatrachus cornutus	1		1					1			1	1
Phrynobatrachus sp. 1	1			1							1	
Phrynobatrachus sp. 2		1	1						1		1	1
Ptychadena perreti	1			1							1	
Schoutedenella poecilonota	1	1	1				1	1	1	1	1	1
Schoutedenella sylvatica	1	1	1				1	1	1	1	1	1
Scotobleps gabonicus		1			1						1	1
Trichobatrachus robustus		1			1						1	1
Xenopus epitropicalis	1	1					1				1	1
Xenopus fraseri	1			1							1	
TOTALS	20	22	17	8	7	2	11	10	13	8	32	26
RELATIVE PERCENTAGE				40.0	31.8	11.8					94.1	76.5

Species Accounts

Order Anura: Family Arthroleptidae: Genus *Arthroleptis*

The Frétey and Blanc (2000) list of Gabon amphibians does not distinguish between the genera *Athroleptis* and *Schoutedenella*, nor does Poynton's (1999) list for Sub-Saharan Africa. As a taxonomic unit this group is reputably problematic with 33 recognized species (Poynton 1999) and numerous synonyms (Frost 2000). Future studies endeavoring to sort out this enigmatic complex should place emphasis on recording call data. Five *Arthroleptis* species are listed for Gabon (Frétey and Blanc 2000), but three of these may be treated as being members of *Schoutedenella*. We recorded only one species of *Arthroleptis*.

Arthroleptis variabilis Matschie 1893

SAM 51006–9, 51060. Sites 5 and 9. A single specimen was collected at site 5, whereas the remaining four specimens were found active during the day in leaf litter right at the top of the mountain. Two small, unidentified snails were present in the stomach of SAM 51009.

Genus *Cardioglossa*

Frétey and Blanc (2000) listed two *Cardioglossa* species from Gabon and they listed another two species (*C. escalarae* and *C. gratiosa*) that may occur here. We confirmed the occurrence of *C. gracilis* and *C. leucomystax* in Gabon and recorded another, as yet unidentified, species.

Cardioglossa gracilis Boulenger 1900

SAM 50962–66, 51035. Sites 5, 6, 8, and 9: A common species throughout the elevational range.

Cardioglossa leucomystax (Boulenger 1903)

SAM 50970–72, 51036. Sites 6 and 8: Recorded from lower and middle elevational ranges.

Cardioglossa sp. 1

Fig. 3. SAM 50967–69, 51031. Sites 8 and 9: Tape recordings of calling males were made at Camp 1 and a total of four specimens were collected. Further comparisons with literature and various type material are needed before a positive identification can be made.

Genus *Schoutedenella*

See general discussion under the *Arthroleptis* account above. We could identify two species from the Monts Doudou material, but more may possibly be present. It is particularly difficult to identify juvenile specimens.

Schoutedenella poecilonota (Peters 1863)

SAM 51176–79. Sites 5, 6, 8, and 9: Present throughout the elevational range.

Schoutedenella sylvatica Laurent 1954

SAM 51203–10. Sites 5, 6, 8, and 9: Present throughout the elevational range.

Schoutedenella sp. 1

SAM 51211–18. Sites 5 and 6: These specimens may represent a different taxon or they could be juveniles of *S. poecilonotus*. We have assumed the latter and have included pitfall capture records of these specimens with that of *S. poecilonotus* and we do not list it as an additional species for this region (see Table 2).

Family Astylosternidae: Genus *Astylosternus*

Poynton (1999) listed 11 species for Sub-Saharan Africa. Only *A. batesi* is known from Gabon (Frétey and Blanc 2000).

Astylosternus batesi (Boulenger 1900)

SAM 51076–79. Site 9: This species was only found along small streams at the highest elevations.

Genus *Scotobleps*

A monotypic genus with previous records from Gabon (Frétey and Blanc 2000).

Scotobleps gabonicus Boulenger 1900

SAM 51003–5, 51034. Site 8: A few specimens were calling from the riverbank at Camp 2.

Genus *Trichobatrachus*

A monotypic genus not previously recorded from Gabon according to Frétey and Blanc (2000). In addition to our Monts Doudou record, *Trichobatrachus robustus* was recently also recorded from Gabon by Lötters et al. (2000) and Lötters et al. (2001). A specimen (FMNH 75058) in the Field Museum of Natural History, Chicago, was collected in Gabon by H. A. Beatty on 14 September 1951.

Trichobatrachus robustus Boulenger 1900

SAM 50950. Site 8: A single adult male was collected sitting on riverbank at night. No other specimens were observed.

Family Bufonidae: Genus *Bufo*

According to Poynton's (1996) scale for mapping African *Bufo* species diversity, four to six species are known from the five-degree grid cell in which Monts Doudou is situated. Frétey and Blanc (2000) listed eight species of *Bufo* from Gabon. We recorded four of these during our survey.

Bufo camerunensis Parker 1936

SAM 51224–34. Sites 5, 6, 8, and 9: A common species throughout the elevational range, but none were observed calling.

Bufo gracilipes Boulenger 1899

SAM 51221–23. Site 5: Three specimens were captured in pitfall traps.

Bufo maculatus Hallowell 1855 "1854"

SAM 51197–51201. Site 1: This species was not encountered in the forest localities, i.e., sites 2 to 9. It was, however, quite common in savanna habitat at Doussala where it was observed calling.

Bufo tuberosus Günther 1859 "1858"

SAM 51044. Site 8: A single adult specimen was collected in leaf litter. Photo in Burger (2002).

Genus *Nectophryne*

Both of the species that make up the genus *Nectophryne* have been recorded from Gabon (Frétey and Blanc 2000). We recorded only *N. batesii*. Poynton's (1996) map of non-*Bufo* African bufonids projects 5 to 6 species of the *Nectophryne* group occurring in the five-degree grid cell which covers northern Gabon and Cameroon, but none are recorded for the grid cell which covers Monts Doudou.

Nectophryne batesii Boulenger 1913

AM 51063–64. Site 8: The only two individuals found during the survey were collected incidentally by Brian Fisher whilst beating branches for ants and by Simon van Noort whilst sweeping through foliage with a net to collect insects.

Family Hemisotidae: Genus *Hemisus*

According to Laurent (1972) and Frétey and Blanc (2000), no members of the Hemisotidae are known to occur in Gabon.

Hemisus perreti Laurent 1972

Fig. 4. SAM 50947–48, 50951–61, 51051. Sites 5 and 6: We captured 53 individuals in pitfall traps set at Camp 1. Captures were always associated with periods of substantial rainfall.

Family Hyperoliidae: Subfamily Hyperoliinae: Genus *Acanthixalus*

A monotypic genus known from Bioko, Cameroon, Equatorial Guinea, Gabon, Congo, and DRC (Frétey and Blanc 2000).

Acanthixalus spinosus (Buchholz and Peters 1875)

SAM 51058, 51220. Site 2: A sample of 14 tadpoles (SAM 51220) at various stages of development were collected from a water-filled, tree hole on 29 February 2000. Total lengths of tadpoles measured between 29 and 52 mm. A few eggs (<10) were hanging from a jelly strand at the tree hole entrance. Only one tadpole had well-developed hind legs when collected. This individual was kept alive until it completed metamorphoses 10 days later at which time it was photographed and preserved (SAM 51058).

Genus *Afrixalus*

Four species of *Afrixalus* are known from Gabon (Frétey and Blanc 2000). We recorded one of these, *A. fulvovittatus*, and another that could not be identified.

Afrixalus fulvovittatus (Cope 1861 "1860")

SAM 51010–13, 51056. Site 1: Males were observed calling from grass stalks in marshy habitat. The coloration and patterning of these individuals conform with the *A. fulvovittatus* (type B) descriptions in Schiøtz (1999).

Afrixalus sp. 1

SAM 51014–17, 51055. Site 3: Specimens were observed calling from grass and other low vegetation at fringes of marsh. Unfortunately the tape-recording made for this species was spoiled. This species does not fit any of the descriptions of the Afrixalus species recognized by Schiøtz (1999).

Genus *Alexteroon*

The genus *Alexteroon* was monotypic with *A. obstetricans* as the type species. However, two new species were recently described by Amiet (2000). One of the new species, *A. hypsiphonus*, is known from a few Gabon localities and the probable occurrence of *A. obstetricans* in Gabon was anticipated (Amiet 2000). Our record from southwestern Gabon confirms Amiet's prediction.

Alexteroon obstetricans (Ahl 1931)

SAM 51026. Site 6: One individual was collected by Steve Goodman who found it at night climbing about a wooden pole from which a mistnet was set. Its coloration and patterning conforms well with the illustration of *A. obstetricans* in Schiøtz (1999: 86). First record of this species from Gabon.

Genus *Hyperolius*

Hyperolius contains 90 species in Sub-Saharan Africa, making it the anuran genus with the greatest number of species in this region (Poynton 1999). Only eight species are listed from Gabon by Frétey and Blanc (2000), but Lötters and colleagues (2001) added *H. mosaicus* and provided apparently the first proven records for *H. phantasticus* and *H. pardalis*. Eight species were recorded during the Monts Doudou survey. Two of these, *H. guttulatus* and *H. nasutus*, are new for Gabon and another two (possibly three) appear to be undescribed taxa.

Hyperolius cinnamomeoventris Bocage 1866

SAM 51188–96. Sites 1 and 3: A common species at marshy habitats. A female was observed during the day clutching an egg-mass attached to herbaceous vegetation growing in shallow water.

Hyperolius guttulatus Günther 1858

Fig. 5. SAM 51027–30. Site 3: A conspicuous species observed calling from floating vegetation and up to a meter above the water's surface. First record of this species for Gabon.

Hyperolius nasutus Günther, 1865 "1864"

Fig. 6. SAM 51162–68. Sites 1 and 3: Observed calling from thin reeds on the edge of swamps in savanna and forest/savanna ecotone. Not listed by Frétey and Blanc (2000) and thus appears to be the first record of this species from Gabon. Species identification is based on an assessment of advertisement calls within the *H. nasutus* complex (Channing et

al. 2002). According to this study the material from Kouilou River basin in the Congo (Largen and Dowsett-Lemaire 1991) are also referable to *H. nasutus*.

Hyperolius ocellatus Günther 1859 "1858"

SAM 50992, 50994–95, 51053, 51131. Sites 6, 8, and 9: A common species at all three elevational sectors. Males were observed calling from leaves and thin branches 1 to 3 m up in trees. This species is strongly sexually dimorphic with females being considerably larger and completely different in color and patterning.

Hyperolius tuberculatus Mocquard 1897

SAM 51018–22. Site 3: A common species at site 3. Males were calling lowdown from trees adjacent to marshy habitat.

Hyperolius sp. 1

Fig. 7. SAM 51023–25. Site 3: This species superficially resembles *Hyperolius bobirensis* Schiøtz 1967 and *H. zonatus* Laurent 1958 in respect to coloration and patterning. However, the call is very different from those species and we believe that our specimens may in fact represent an undescribed taxon. A few individuals were observed calling from emergent vegetation.

Hyperolius sp. 2

Figs. 8 and 9. SAM 51156–57. Site 3: A small *Hyperolius* which could not be identified by us. Tape recordings of calling males were taken.

Hyperolius sp. 3

SAM 51158–61. Site 3: A small series of what appears to be another undescribed species of *Hyperolius* was collected at site 3, but vocalizations were not heard.

Subfamily Kassininae: Genus *Kassina*

No *Kassina* species were known from Gabon (Frétey and Blanc 2000).

Kassina sp. 1

Fig. 10; see also color illustration in Burger (2002b). SAM 51065–75. Sites 5 and 6: Fifteen individuals were collected in pitfall traps at site 5 and two individuals were collected in pitfall traps at Camp 1. These appear to be all females. Calling *Kassina* males were recorded at site 3, but unfortunately no individuals were observed to link these calls with the taxon collected at sites 5 and 6. Surprisingly these records seem to be the first for *Kassina* from Gabon.

Genus *Phlyctimantis*

Of the four recognized species in this genus (Poynton 1999), only *P. leonardi* has been recorded from Gabon (Frétey and Blanc 2000). However, Lötters and colleagues (2001) consider their material to be *P.* cf. *boulengeri* instead.

Phlyctimantis leonardi (Boulenger 1906)

Site 3: Although no individuals were directly observed, the tape recordings made of a chorus at site 3 confirms the occurrence of this species at the study area. The Monts Doudou recordings agree with some made at Pointe Ngombe, at Ekwata, 16 km 240° WSW of Libreville, 00°19.58′N, 09°18.92′E (M. Burger pers. observ., 26 March 2000). Species

FIGURE 3. *Cardioglossa* sp. 1, recorded from Camps 1 and 2.

FIGURE 4. *Hemisus perreti*, first record of Hemisotidae from Gabon.

FIGURE 5. *Hyperolius guttulatus*, first record of this species in Gabon.

FIGURE 6. *Hyperolius nasutus*, first record of this species in Gabon.

identification at Ekwata was verified when calling males were photographed and specimens examined.

Subfamily Leptopelinae: Genus *Leptopelis*

Frétey and Blanc (2000) listed 10 *Leptopelis* species from Gabon. We recorded five of these and one other which must still be identified.

Leptopelis aubryi (Duméril 1856)

SAM 50986–87, 51033. Site 1: A few individuals were observed at Doussala calling from reeds and low herbaceous vegetation in marshy habitat.

Leptopelis calcaratus (Boulenger 1906)

SAM 51089–93, 51169. Sites 6 and 9: The calls of this species were heard every night at Camp 1. Males of this species called from 5 m up or higher in trees. It was not recorded at the mid-elevation camp. At Camp 1 individuals called within meters from calling *Leptopelis millsoni*.

FIGURE 7. *Hyperolius* sp. 1, unidentified species, which appears to be an undescribed taxon.

FIGURE 8. *Hyperolius* sp. 2, color variation in male.

FIGURE 9. *Hyperolius* sp. 2, color variation in male.

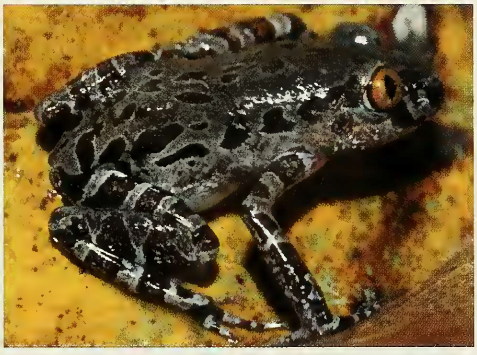

FIGURE 10. *Kassina* sp. 1, first record of this genus for Gabon.

Leptopelis ocellatus (Mocquard 1902)

SAM 50982–85, 51083. Sites 8 and 9: Specimens were observed calling from between 1 and 3 m up in trees along streams. Color photo of Monts Doudou specimen was published in Burger (2002b).

Leptopelis millsoni (Boulenger 1895 "1894")

SAM 51087–88. Site 6: Males called from 5 m up and higher in trees every night at Camp 1.

Leptopelis rufus (Reichenow 1874)

SAM 51085–86. Site 8: Two individuals found on branches along river at Camp 2. Color photo of SAM 51085 in life was published in Burger (2002a). No calling was heard for this species.

Leptopelis sp. 1

SAM 51394. Site 10: A single individual, collected after the survey period, still needs to be identified.

Family Petropedetidae: Genus *Dimorphognathus*

The recognition of a Petropeditidae is likely to be dropped by future workers, but is retained here for the sake of consistency in following Frost (2000). *Dimorphognathus* is a monotypic genus with previous records from Gabon (Frétey and Blanc 2000).

Dimorphognathus africanus (Hallowell 1857)

SAM 51170–75. Site 6, 8, and 9: The conspicuous calling of this frog was heard every day at all three camps.

Genus *Phrynobatrachus*

Phrynobatrachus has the second largest number of species in the African anura with 65 Sub-Saharan species (Poynton 1999) and still more being described (e.g., Drewes and Perret 2000). Only five species are known from Gabon (Frétey and Blanc 2000). The Monts Doudou material also comprises five species, but only two were positively identified by us. The remaining three species must still be compared with other museum voucher specimens before final identifications are made.

Phrynobatrachus auritus Boulenger 1900

SAM 50996–51001, 51037–39. Sites 5 and 6: Collected opportunistically at Camp 1, but several individuals were also captured in pitfall traps at site 5.

Phrynobatrachus cornutus (Boulenger 1906)

SAM 51184–87. Sites 6 and 9: All individuals were collected from leaf litter during opportunistic searches.

Phrynobatrachus sp. 1

Fig. 11. SAM 51182–83. Site 4: Two male individuals were collected from leaf liter whilst active during the day.

Phrynobatrachus sp. 2

Fig. 12. SAM 50988–91, 51061. Site 8 and 9: A small, vividly marked species found in muddy terrain near small streams. Males were observed and taped whilst calling during the day and at sunset.

Phrynobatrachus sp. 3

Fig. 13. SAM 51081–82. Site 3: A common, seemingly diurnal, species observed in association with shallow swamp habitat.

Genus *Petropedetes*

Up until recently *Petropedetes newtoni* was the only representative of this genus from Gabon (Frétey and Blanc 2000). However, Lötters and colleagues (2001) recorded another two species (*P. palmipes* and *P. parkeri*). The Monts Doudou material appear to be different from these three species.

Petropedetes sp. 1

Fig. 14. SAM 51002, 51052, 51181. Sites 8 and 9: Two adults and one juvenile were collected during nocturnal searches, but none were heard calling.

Family Pipidae: Subfamily Xenopodinae: Genus *Xenopus*

Our use of the genus *Xenopus* instead of *Silurana* (see Cannatella and Trueb 1988) follows Kobel et al. (1996). The Monts Doudou material included two of the three *Xenopus* species listed by Frétey and Blanc (2000). They also listed *X. andrei* and we add *X. sudanensis* for Gabon.

Xenopus epitropicalis Fischberg, Colombelli and Picard 1982

SAM 51134–50, 51155. Sites 5, 6 and 8: Although this was by far the most common species captured in the pitfall traps (138 in total), it was very seldom encountered in its natural habitat. A few individuals were observed in shallow mud pools on the forest floor.

Xenopus fraseri Boulenger 1905

SAM 51151. Site 7: A single individual was found in a water-filled elephant spoor.

Xenopus sudanensis Perret 1966

SAM 51123. Site 3: An adult was collected from a shallow pond. This taxon is new for Gabon.

An individual (SAM 51219) of what may be a fourth species of *Xenopus* was collected from a small dam at Doussala (site 1). The specimen is a newly metamorphosed juvenile, therefore identification is difficult.

Family Ranidae: Genus *Amnirana*

Three species are known from Gabon (Frétey and Blanc 2000), but we did not record *Amnirana albolabris*.

Amnirana amnicola (Perret 1977)

SAM 51098–109. Sites 8 and 9: A very common species that was often observed on vegetation adjacent to small streams. Males were occasionally heard calling at night.

Amnirana lepus (Andersson 1903)

SAM 51094–97. Site 8: Only four individuals were encountered during opportunistic searches at Camp 2.

Genus *Conraua*

Six species are recognized in this genus (Frost 2000), but only *Conraua crassipes* is known from Gabon (Frétey and Blanc 2000).

Conraua crassipes (Buchholz and Peters 1875)

SAM 51110–22, 51130. Sites 6, 7, 8, and 9: Patrice Christy identified the characteristic call of this species at site 9. Specimens were most often observed at night on rocks in slow- and fast-flowing streams. An individual was also found in a shallow muddy pool more than 100 m away from any streams.

Genus *Hoplobatrachus*

Not listed for Gabon by Frétey and Blanc (2000), but recently recorded by Lötters et al. (2001). A specimen (FMNH 75061) in the Field Museum of Natural History, Chicago,

FIGURE 11. *Phrynobatrachus* sp. 1, found in leaf litter at site 4.

FIGURE 12. *Phrynobatrachus* sp. 2, called during the day at Camps 2 and 3.

FIGURE 13. *Phrynobatrachus* sp. 3, from marshy habitat at site 3.

FIGURE 14. *Petropedetes* sp. 1 from Camp 2.

was collected in Gabon by H. A. Beatty on 21 August 1951, but this record was never published.

Hoplobatrachus occipitalis (Günther 1859 "1858")

SAM 51045–46. Site 1: A common species observed in association with small dams in and around Doussala village.

Genus *Ptychadena*

Six species of *Ptychadena* are known from Gabon (Frétey and Blanc 2000), three of which were recorded during the Monts Doudou survey.

Ptychadena aequiplicata Werner 1898

SAM 51057. Site 5: A single individual was collected by Violaine Nicolas.

Ptychadena perreti Guibé and Lamotte 1958

SAM 51062. Site 4 and 7: A few individuals were observed in damp grassy habitat at forest fringes along an old logging road.

Ptychadena pumilio (Boulenger 1920)

SAM 51059. Site 3: A single individual was taped whilst calling from the edge of a marsh. No other individuals were observed. This species was referred to as *Ptychadena taenioscelis* by Largen and Dowsett-Lemaire (1991).

Family Rhacophoridae: Subfamily Rhacophorinae: Genus *Chiromantis*

Schiøtz's (1999) distribution map for *Chiromantis rufescens* shows no records for Gabon, but it is listed by Frétey and Blanc (2000).

Chiromantis rufescens (Günther 1868)

SAM 50949, 51042. Site 8: A few foam nests were observed on vegetation overhanging a small muddy pool in the forest (P. Christy pers. comms., 8 March 2000). This locality was visited again on 12 March at night during which time a few males were collected from adjacent vegetation. Surprisingly, no observations of this species were made at any of the other sites.

Species Accounts

Reptilia

Species accounts start with specimen accession numbers (PEM R = Port Elizabeth Museum), followed by the various localities (sites 1–9) at which a particular species was recorded. The MB accession numbers are for specimens that will be deposited in a Gabon collection.

Suborder Sauria: Family Chamaeleonidae: Genus *Rhampholeon*

Only one chameleon species was recorded during this survey. A number of species in the genus *Chamaeleo* (e.g., *C. oweni* and *C. cristatus*) may also be expected in the region.

Rampholeon spectrum (Buchholz 1874)

PEM R 15697–98, 15700–1. Sites 8 and 9: Three individuals were found at night sleeping on vegetation about 50 cm high; two were also collected during the day. The single female (PEM R 15697, 57 + 16 mm) contained two large ova (8–9 mm diameter) and a large grasshopper in the stomach. Three adult males (largest 56 + 23 mm) have well-everted hemipenes.

Wild (1994), describing ecological observations on *R. spectrum* from Cameroon, noted maximum snout-vent lengths of 57 mm and 58 mm for female and males, respectively. The roosting sites of the Monts Doudou specimens also conform to Wild's observation (1994), that noted that 91% of night-time roosts were below 100 cm. Grasshoppers were rare in the diet (one record out of 32) of Cameroon *R. spectrum* (Wild 1994). The two large ova in the Monts Doudou female conform to the typical clutch of two eggs recorded elsewhere (Wild 1994).

In a review of hemipenial morphology in the Chamaeleonidae, Klaver and Böhme (1986) noted that the hemipenis of *R. platyceps* (Malawi) lacked calyces. For Cameroon *R. spectrum* they noted that the hemipenes were "like those of the previous species, but instead of apical horns there are two complex apical projections." These are denticulate flanges that comprise a main flange, with seven denticles on the crest and 2–3 additional denticles on the lateral surface and a smaller flange with up to five denticles. The morphology of the Monts Doudou material differs in details from Klaver and Böhme's (1986) de-

scription. Unlike the inference that *R. spectrum* lacks calyces, all the Gabon everted hemipenes display well-developed, fine lateral flounces on the asulcal surface. These anastamose to calyces distally. The sulcus spermaticus drains into a large apical V-shaped nude basin [also unrecorded by Klaver and Böhme (1986) in Cameroon material], which at the outer tips of the arms bears complex denticulate flanges. These differ in the number of denticles from those recorded for Cameroon material. Denticles on the main flange vary from 10–12 (mean 10.75), on the lateral surface of the main flange from 2–3 (mean 2.4), and on the smaller flange from 6–7 (mean 6.17). Denticle counts on both flanges are significantly higher than those recorded for Cameroon materal. Although hemipenial morphology is useful in *Rhampholeon* systematics (Tilbury and Emmrich 1996), caution is necessary in assessing the taxonomic significance of the observed difference between Monts Doudou and Cameroon material. Bryoo and Domergue (1971) and Böhme (1988) have both noted seasonal variation in hemipenial ornamentation in chameleons. The higher denticle counts in Monts Doudou males may therefore reflect seasonal differences between the populations. However, Wild (1994) noted breeding throughout the year in Cameroon, and similar aseasonal breeding is likely in Monts Doudou. The taxonomic significance of these hemipenial differences between Gabon and Cameroon populations needs further investigation.

Family Gekkonidae: Genus *Hemidactylus*

Hemidactylus fasciatus Gray 1842

PEM R 15699, 15707, 15711, 15713. Sites 5, 6, 8, and 9: These large forest geckos were encountered at night about 1.5 m up on trees with smooth trunks, on all occasions in a head-down position. A large male with original tail (78 + 96 mm) has mature, active testis. Two of the three females are gravid, each with a single egg (12 × 9–10 mm) in each oviduct. The largest female had a SVL 84 mm. A non-gravid female had a full stomach containing the remains of a large centipede, small millipede and large grasshopper. Schmidt (1919) recorded a maximum female SVL of 77 mm, but with an exceptional male reaching 95 mm SVL.

Hemidactylus muriceus Bocage 1873

PEM R 15691–92. Sites 5 and 6: Two individuals were collected during opportunistic searches. A large female (49 + 43 mm) contains two developing ova (4.5 mm diameter). The male (41 + 45 mm) has well-developed hemipenial bulges but only eight preanal pores.

The taxa *H. muriceus, H. ansorgei, H. echinus*, and *H. longicephalus* are difficult to distinguish (Schmidt 1919; Loveridge 1947; Dunger 1968), and Böhme (1975) has noted that *H. longicephalus* and *H. ansorgei* are probably best treated as synonyms of *H. muriceus. Hemidactylus echinus* can also be confused with *H. muriceus*, but can be distinguished by its digital webbing, denser tuberculation including the presence of two rows of subcaudal tubercles, and higher subdigital counts (Loveridge 1947). The complex is in need of a modern revision, and the present specimens are provisionally referred to *H. muriceus* on the basis of the lack of obvious digital webbing; sparse and irregular dorsal tubercles (which at most forms 11–13 poorly defined rows); presence of only one internasal granule; number of scansors under the first (6–7) and fourth toe (8–10); lack of subcaudal tubercles; the light scattering of brown infusions on the ventrum; and rain forest habitat.

Hemidactylus cf. *mabouia* (Moreau de Jonnès 1818)

Site 1: Another species of *Hemidactylus* (cf. *H. mabouia*) was observed on buildings in the Doussala village. One individual was captured, but unfortunately managed to escape later. Future surveys in this region should endeavor to collect voucher material of this gecko species.

Family Gerrhosauridae: Subfamily Gerrhosaurinae: Genus *Gerrhosaurus*

Lang (1991) presented a phylogenetic study supporting recognition of the familial status of the Gerrhosauridae within Cordyliformes, and separation of the African Gerrhosaurinae from the Madagascan sister taxon Zonosaurinae. However, Odierna and colleagues (2002) have presented additional molecular and chromosomal evidence that genetic divergence in Cordyliform lizards is low. They recommend only subfamilial status for plated lizards within the Cordylidae. Because these relationships remain unresolved and are the subject of ongoing studies, we provisionally retain the use of familial status.

Gerrhosaurus nigrolineatus Hallowell 1857

Site 1: Four individuals were observed dashing across bush paths in savanna habitat, but unfortunately none could be captured.

The *Gerrhosaurus nigrolineatus* complex is in need of revision (Broadley *in litt.* November 2000). The type locality of *G. nigrolineatus* is Gabon, and populations south and east, previously referred to *G. nigrolineatus*, may best be referable to another taxon.

Family Scincidae: Subfamily Feyliniinae: Genus *Feylinia*

Greer (1970) stabilized the scincid subfamilial relationships, and recognized the Feyliniinae containing the genera *Feylinia* and *Chabanaudia*. Brygoo and Roux-Esteve (1983) subsequently placed *Chabanaudia* in the synonymy of *Feylinia*. In their revision of the genus, Brygoo and Roux-Esteve (1983) recognized six species, validating four species previously placed in synonymy. Three species are currently recognized from Gabon; the wide-ranging species *Feylinia currori* and *F. grandisquamis*, and the minute (<100 mm TL) *F. boulengeri*, which is endemic to Gabon. Brygoo and Roux-Esteve (1983) differentiated *F. grandisquamis* from *F. currori* solely by the number of midbody scale rows (MSR 19–21 vs. 23–28, respectively) and size (<200 mm TL vs. >300 mm TL, respectively). The Monts Doudou material has 21 MSR and an adult size of <200 mm, and is thus referable to *F. grandisquamis*. Further studies of species boundaries within the genus, preferably supported by genetic analysis, are needed. The biology and distribution of these unusual burrowing skinks also remains poorly known.

Feylinia grandisquamis Müller 1910

PEM R 5242–44, 15712, 15694–95. Sites 6, 8, and 10: Two individuals were found in leaf litter and a third behind a termitarium that was constructed against a tree trunk. Surprisingly, no individuals were collected in pitfall traps. Both females were gravid; one (116 + 63 mm) contained a single large egg (14–15 × 6 mm) in each oviduct, without discernable embryos; the other (120 + 43 mm) also contained an egg (21 × 10 mm) in each oviduct, one of which contained a well-developed embryo (approximate TL 30–40 mm). The hemipenis of the male (PEM R 15694) is everted; it is simple with the sulcus spermaticus draining into two small apical cups that are separated by a prominent apical flap; the base and sulcal folds are nude; the asulcal surface of the apical flap bears shallow papillate flounces.

Brygoo and Roux-Esteve (1983) listed only two other localities (Ogouma and Alima Leketi) for *F. grandisquamis* in Gabon.

Subfamily Lygosominae: Genus *Mabuya*

Hoogmoed (1974) reviewed Ghanian *Mabuya*, discussing species from the adjacent Congo basin, including Gabon. He validated *M. albilabris*, previously considered a synonym of *M. blandingii*, as a good species, and also showed that *M. affinis* (Gray 1838) had priority over *M. blandingii* (Hallowell 1844).

Mabuya affinis (Gray 1838)

PEM R 15715, 15720, 15722–23, MB 5070, 5122. Sites 4, 5, and 7: A few individuals were observed during the day on fallen trees and on the ground along an old logging road. Five eggs found under a stone hatched on 22 March 2000. Two of the hatchlings measured 26 + 41 mm and 26 + 45 mm. The largest male had a SVL 78 mm; the other had an original tail, 67 + 130 mm. Previous maximum male size had been 76 mm (Ghana and Ivory Coast; Hoogmoed 1974). Both males were sexually mature with well-developed, active testes. The largest had a well-everted hemipenis of unusual structure. The organ was divided for half its length, with the sulcus spermaticus dividing in the crotch. The arms had three, thick, unornamented longitudinal ridges that give them a triangular cross-section. Along one of the ridges on each arm a fork of the sulcus runs to the tip, where two small papillae occur. Between the ridges on the arms run parallel, shallow horizontal flounces. Hoogmoed (1974) noted earlier Gabon specimens from Benito River and Mitzii (= Mitzic ?).

Mabuya albilabris (Hallowell 1857)

PEM R 5245–50. Site 10: Although similar to, and easily confused with *M. affinis*, the Monts Doudou material confirms Hoogmoed's (1974) diagnostic features separating the two species; i.e., only one scale between the fourth suprocular and the anterior supratemporal (two in *M. affinis*), and lower subdigital lamellae counts. Hoogmoed (1974) also noted that a pale lateral body stripe (yellowish in life) may or may not be present. It is now evident that this is due to sexual dimorphism. Analysis of additional Gabon material from Gamba and Rabi revealed that the pale lateral line is present in juveniles and mature females (67–71 mm SVL), but absent in sexually mature males (65–70 mm SVL). The latter develop a dark brown rusty infusion to the dorsum and a bright lime yellow ventrum. A prominent rust red spot occurs on the side of the neck in front of the forelimbs, and the throat is bright grey with dark-emargined scales.

Of three large females (67–71 mm SVL), two were gravid, PEM R 5248 containing two enlarged ova (5 mm diameter) and PEM R 5250 with three fully developed eggs (13–14 ×8–9 mm). The latter had thickened shells, but no sign of embryonic development. An additional Gabon female from Gamba also had two large eggs without embryonic development. Therefore it is probable that the species is oviparous, supporting Hoogmoed's (1974) supposition. The species inhabited forest floor, and this is reflected in the gut contents, which included mostly grasshoppers (four stomachs), with a large spider in another. The stomach of a large male (65 mm SVL) also contained a juvenile *Mabuya albilabris*, the first record of cannibalism in the species.

Mabuya polytropis Boulenger 1903

PEM R 5251, 15714, 15717, 15719, 15721. Sites 4, 5, 8, and 10: Observed on fallen trees during daytime. Both large females were gravid; PEM R 15719, 83 mm SVL, con-

tained 2 + 2 large eggs (16 × 9 mm) ready for laying; PEM R 15714, 85 mm SVL, contained 2 + 1 smaller eggs (6 mm diameter). A smaller male (65 mm SVL) had immature testes; the stomach contained the body of a large spider. The stomach of an immature female contained two mole crickets.

Genus *Leptosiaphos*

Leptosiaphos breviceps (Peters 1873)

PEM R 5267–68, 15716, 15718. Sites 5, 8, and 10: Collected in pitfall traps at site 5 and in leaf litter at Camp 2. The large female (53 mm SVL) contained 2 + 1 eggs (11 × 6 mm) that appear ready for laying. Two females were gravid: one (53 mm SVL) contained 2 + 1 eggs (11 × 6 mm) that appeared ready for laying; another (59 mm SVL) contained a single enlarged (4 mm diameter) ovum in each oviduct. A large male (61 mm SVL) is sexually mature, with large active testes. As noted by Perret (1973) the species displays sexual dimorphism, with the male having mottled flanks, unlike the prominent white lateral stripe of females. Gabon is the type locality for this forest species, which reaches a maximum SVL of 65 mm (Fuhn 1972). This species was transferred from the genus *Panaspis* to *Leptosiaphos* by Broadley (1989a) in an expanded subgenus *Lacertaspis*.

Suborder Serpentes

Family Atractaspididae: Subfamily Atractaspidinae: Genus *Atractaspis*

Four species of *Atractaspis* have been recorded from Gabon (Laurent 1950), only one of which was obtained during the survey.

Atractaspis corpulenta (Hallowell 1854)

PEM R 5257, 15689. Sites 5 and 10: The large (563 + 43 = 606 mm) female (PEM R 15689) was active in the early evening. The gut was empty and only small ova (<5 mm) were present. The male (PEM R 5257) was mature (425 + 38 mm), but the testes were inactive. The retracted hemipenis extended to the 7th subcaudal and was shallowly forked (dividing at 6th subcaudal). Ornamentation comprised seven rows of flounced spinose rows, the sulcus running centripetally to the fork between the shallow arms.

Family Boidae: Subfamily Erycinae: Genus *Calabaria*

Kluge (1993) demonstrated that the genus *Calabaria,* long considered a burrowing relative of pythons, shared numerous synapomorphies with erycine boids. The transfer of the only species to the Erycinae was well founded. However, his inclusion of the species with two New World erycines in the genus *Charina* remains more problematic and we choose not to follow it. Although taxonomically conservative, it obscures important differences between the Old and New World congeners, not least the differing reproductive modes.

Calabaria reinhardtii (Schlegel 1848)

PEM R 15708. Site 9: An adult female (782 + 65 mm) was found curled up in a hollow of a fallen tree.

Family Colubridae: Tribe Lamprophiini: Genus *Bothrophthalmus*

Bothrophthalmus lineatus (Peters 1863)

PEM R 5266. Site 10: A large female (746 + 176 mm). The stomach contained a large unidentified rodent. The specimen conforms to the *brunneus* phase, lacking the usual prominent body stripes; coloration is uniform brown with orange-red ventrum with dusky infusions on the subcaudals and lateral edges of the ventrals. Roux-Esteve (1965) noted that, apart from color, no other features distinguished *B. lineatus brunneus* Günther 1963 from typical *B. lineatus*, and considered the race invalid. However, only the *brunneus* phase has been recorded from Gabon and further studies of the situation are merited.

Tribe Lamprophiini: Genus *Mehelya*

In the last revision of the genus *Mehelya*, Loveridge (1939) recognized seven species including *M. poensis, M. capensis, M. crossii, M. nyassae, M. stenophthalmus, M. guirali*, and *M. riggenbachi*. Three additional species have been described subsequently: *M. vernayi* (Angola), *M. laurenti* (Congo and DCR) and *M. egbensis* (Nigeria). The two latter species remain poorly known, and no further specimens have been recorded since the type descriptions. The main distribution of the genus is around Cameroon (four species) and Nigeria (five species).

Mehelya capensis savorgnani (Mocquard 1887)

PEM R 5263. Site 10: A large male (850 + 151 mm). The stomach contained two undigested frogs (snout-burrowers, *Hemisus* cf. *perreti),* whilst the hindgut contained indeterminate mammal bones and hair. *Mehelya capensis* is traditionally considered to be a specialist ophiophage. However, Shine and colleagues (1995) reviewed dietary records for the genus and noted that *M. capensis* ate almost as many lizards as snakes, and that the few amphibian records were all bufonids. The lack of snake scutes associated with the mammal hair in the hindgut indicates that the above item was primary prey, and not secondarily ingested with snake prey. Hemisotids and mammals have not previously been recorded in the diet of this species.

Mehelya guirali (Mocquard 1887)

PEM R 15709. Site 5: A single female individual was collected (955 + 145 mm). The stomach contained a small bolus of snake scales. Loveridge (1939) recorded no specimens from Gabon. The only other record (MNHN 1896-540) for Gabon is a snake from Lambarene (Broadley *in litt.* November 2000).

Subfamily Incerta cedis: Genus *Grayia*

Grayia ornata (Bocage 1866)

PEM R 5255. Site 10: Only the head of an adult was preserved; 19 scale rows at neck, lower temporal equal in length to distance from loreal, and eight lower labials.

Subfamily Colubrinae: Genus *Boiga*

Chippaux (2001) placed African *Boiga* in the genus *Toxicodryas*, although this was not supported by Rasmussen's (1979) analysis of boigine snakes.

Boiga pulverulenta (Fischer 1856)

PEM R 15690. Site 6: A single female individual (SVL 867 mm, tail truncated) was collected. It was active in a tree about one hour after sunset. It approaches the maximum SVL recorded for the species (unsexed, 880 mm, Ghana; Pitman 1974). Like other specimens from Rabi (unpubl. observ.) it has 21 MSR (19 is typical for the species). This condition, previously unreported in the species (Rasmussen pers. comm., 23 May 2002), can cause confusion with *B. blandingii*. The two species are best distinguished by the vertebral scale row, which in *B. blandingii* is twice the width of the adjacent scales, but only slightly larger in *B. pulverulenta*.

Genus *Crotaphopeltis*

Crotaphopeltis hotamboeia (Laurenti 1768)

PEM R 5256, 15702–5. Sites 7 and 10: A relatively small female (361 mm SVL) contained six almost mature eggs (22–27 × 8–10 mm) when captured (date of collection unknown). Five snake eggs were found under a rock on 26 February 2000. These started hatching during the afternoon of 13 March and all individuals had emerged by the next morning. They measured 151–172 mm TL. Egg and hatchling size, as well as the small size of sexually mature snakes, correspond to previous records for southern African snakes (Keogh et al. 2000).

Genus *Dipsadoboa*

Rasmussen (1989) reviewed the *D. duchesnii* complex, restricting *D. duchesnii* to the Central African rain forests, being replaced to the west of the Dahomey Gap by *D. brevirostris*. He listed a number of specimens from Gabon.

Dipsadoboa duchesneii (Boulenger 1901)

PEM R 15724, 15801. Sites 3 and 9: Both individuals were sexually inactive females with empty guts. The largest measured 617 + 227 = 844 mm. The individuals were active at night during rain and were found in close proximity of calling *Hyperolius* species. The individual at site 3 was in reeds close to the water's surface with *H. guttulatus* calling within 50 cm. The individual at site 9 was 1.5 m up in a tree from which *H. ocellatus* were calling. The congener *D. aulica* has also been observed apparently stalking calling hyperoliids in Kwazulu-Natal, South Africa (Branch, unpub. observ.). Rasmussen (1989) recorded a maximum female total length of 990 mm; this was approached by another female (PEM R 15725) of 703 + 235 = 938 mm from Ekwata, Libreville.

Dipsadoboa weileri (Lindholm 1905)

PEM R 5264. Site 10: An adult male (525 + 116 mm). It conforms with Rasmussen's (1993) extended description of the species, with the exception that the loreal is fused with the preocular on one side. The stomach contained two undigested frogs (snout-burrowers, *Hemisus* cf. *perreti)*. The diet suggests that the species may be primarily terrestrial. In support of this supposition, the species also has a stouter build and shorter tail than its mainly arboreal congeners.

Genus *Hapsidophrys*

Broadley (1966) noted that the monotypic genera *Gastropyxis* and *Hapsidophrys* were both poorly differentiated, and formally synonymized the genera. Although this has not

been generally recognised (e.g., Pitman 1974; Rasmussen 1991; Meirte 1992; Akani et al. 1999), we support Broadley's transfer.

Hapsidophrys smaragdina (Schlegel 1837)

PEM R 15710. Site 5: A single male (540 + 367 mm) was caught in a snap-trap set for small mammals.

Genus *Philothamnus*

Philothamnus carinatus (Andersson 1901)

PEM R 5261–62. Site 10: Two adults, one of each sex. Both lack white spots, have vague dark crossbands on the forebody, and have 13 midbody scale rows. The simple hemipenis of the male extends to 6th–7th subcaudal. Ornamentation is typical for the genus, with two enlarged, ossified basal spines, followed distally by 8–10 crenelated spiny rows that reduce in size towards the tip where they are replaced by calyces. The sulcus is undivided and runs to the tip of the organ. Both guts were empty.

Hughes (1985) discussed the difficulty of distinguishing this species from *P. heterodermus,* but validated its specific status (although not giving a full analysis of variation between the two taxa). Both Hughes (1985) and Chippaux (2001) mapped only 1–2 localities (unspecified) for the species in Gabon.

Philothamnus sp. 1

PEM R 15802. Site 7: An advanced embryo was prematurely removed (6 May) from one of three eggs found under a log on 27 February. It is referable to *Philothamnus*, but insufficient detail on scalation and dentition were available for specific identification.

Genus *Rhamnophis*

Broadley and Wallach (2003) have revised the Dispholidini, reviving the genus *Rhamnophis*.

Rhamnophis aethiopissa Günther 1862

PEM R 5265. Site 10: A large male (884 + 504 mm). The stomach contained a *Leptopelis* sp.

Subfamily Natricinae: Genus *Natriciteres*

Natriciteres fuliginoides (Günther 1858)

PEM R 5260, 15706. Sites 8 and 10: A single individual was collected in forest habitat during the surveying period and another subsequently by V. Nicolas. Loveridge (1958) recorded *Natriciteres fuliginoides* in Gabon from Franceville, Lambarene, and Ogooue River.

Family Elapidae: Subfamily Bungarinae: Genus *Dendroaspis*

Dendroaspis jamesonii (Traill 1843)

Site 7: Brian Fisher observed two individuals whilst clearing a road during the two week reconnaissance period prior to the actual survey. He described these snakes to M. Burger who concluded that they were *D. jamesonii*.

Genus *Naja*

Naja melanoleuca (Hallowell 1857)

PEM R 5259. Sites 6 and 10: Voucher specimen is a large decapitated head with prominent black and white barred labials. Fragments of sloughed skin from a large (> 1.2 m) cobra, possibly of this species, were found at Camp 1.

Family Viperidae: Subfamily Causinae: Genus *Causus*

Causus lichtensteini (Jan 1859)

PEM R 5258. Site 10: A large male (361 + 42 mm) with dark coloration, with little indication of dark chevron pattern and lacking the white nape band of juveniles. The gut was empty. The retracted hemipenis extends to the 7th subcaudal, is strongly divided (at the 1st subcaudal), and has a very short nude basal region. Ornamentation comprises approximately seven rows of ossified spines on the proximal 80% of the arms and is calyculate for the remaining distal section.

Subfamily Viperinae: Genus *Atheris*

Atheris squamigera (Hallowell 1856)

PEM R 15695–96. Site 8: A large female (530 + 104 mm) was found about 2 m up a thin-stemmed tree. She contained 10 (8-2) large yolked eggs (10–17 × 14–15 mm); the stomach contained an unidentified mammal and the lower intestine was packed with mammal hair. A color photo of this specimen was published in Burger (2002a). A juvenile (193 + 39 mm) was found on the ground. It had typical, chocolate brown, juvenile coloration, with a light yellow tail tip.

The taxonomy of *A. squamigera* has been the subject of recent debate (Broadley 1998b; Lawson 1999; Lawson and Ustach 2000). Libreville is the type locality of *A. squamigera*, to which the Monts Doudou specimens remain referable.

Genus *Bitis*

Bitis gabonica (Duméril, Bibron and Duméril 1854)

PEM R 5252–54. Site 10: Three small specimens with prominent umbilical scars. A molecular phylogeny of *Bitis* (Lenk et al. 1999) indicated that the two races of *B. gabonica* are best treated as separate species, with western *B. rhinoceros* having closer affinities with *B. nasicornis,* and occurring west of the Dahomey Gap.

Order Crocodylia: Family Crocodylidae: Genus *Crocodylus*

All of the three African crocodile species occur in Gabon. We recorded *C. cataphractus* only, but according to Christian Nziengui (a WWF employee in the Gamba Region), *Osteolamus tetraspis* is known at Monts Doudou from small rivers and pools in forest habitat and the larger *Crocodylus niloticus* is known from the Mougalaba River.

Crocodylus cataphractus Cuvier 1825

Site 3: A single adult (approximate TL 1.5 m) was observed at close range at night. This individual was lying in a swamp with its head resting on the bank and about two-thirds of its body in the water.

Order Testudines: Family Pelomedusidae: Genus *Pelusios*

Iverson (1992) recorded four species of *Pelusios* (*P. carinatus, P. castaneus, P. gabonensis*, and *P. niger)* from Gabon. Bour (2000) has recently described another species, *P. marani*, from the country. We recorded only *Pelusios castaneus*, a common species occurring from northern Angola northwards in all west African countries up to Senegal.

Pelusios castaneus (Schweigger 1812)

PEM R 15687–88. Site 1: A few individuals were observed in small ponds at Doussala. Although no pelomedusids were observed in forest habitat at Monts Doudou, it is expected that some do occur.

Family Testudinidae: Genus *Kinixys*

Kinixys erosa (Schweigger 1812)

PEM R 15684–86. Sites 5, 8, and 9: This was the only reptile species captured by the pitfall traps. Three adults fell into the buckets on three different days at Camp 2 and a juvenile was also collected from this locality. Adult individuals were recorded from altitudes between 110 m and 640 m. *Kinixys erosa* is unusual in that individuals are mostly active at night (Schmidt 1919; Naulleau 1988) and they can swim and dive for food (Broadley 1989b). Gramentz (2001) noted that the species is threatened in Gabon by deforestation and exploitation for food.

Discussion

The 263 amphibian captures over 726 pitfall trap-days (Table 3) translate to a daily capture rate of 36%, a figure which is very high when compared with 2% and 3% recorded for amphibians and reptiles in similar studies conducted in Madagascar (Raxworthy et al. 1998; Nussbaum et al. 1999). This excessive capture rate is primarily a product of high capture numbers of two species, i.e., *Xenopus epitropicalis* (138 specimens) and *Hemisus perreti* (53 specimens), together they account for 73% of the amphibian pitfall captures. Given that high numbers of a few species captured could so radically influence the daily capture rate, is this in fact an appropriate measure for trapping success and comparative survey assessments? We feel that, even though this measure is informative in respect to the extent of pitfall captures, it is not ideal for the type of comparisons that are important for evaluating trapping success. The terms "daily trap success" or "capture success" and "capture rate" have been used intermittently for the same measurement (e.g., Raxworthy and Nussbaum 1996; Raxworthy et al. 1998; Nussbaum et al. 1999; Goodman and Jenkins 1998; Goodman and Hutterer, this volume). We used "capture rate" over "capture success" in evaluating our pitfall results, but we propose that an alternative measure would better serve to assess capture or trapping success.

The calculation for daily capture success or capture rate (*op. cit.*) is the number of captures divided by the total trap-days. The inappropriateness of using this measure is illustrated by the fact that, according to the above definition, the daily capture rate of trap line 2 of Camp 1 was 108% (see Table 3). We propose that daily capture success should be the sum of the number of traps containing frogs divided by the number of trap-days calculated on a daily basis, divided by the number of days (survey period). In order to use this formula, the field data being recorded must note the daily results of individual pitfall traps and

not merely the combined daily results of each trap line. We did not do this ourselves unfortunately, and thus we could not apply this formula to the Monts Doudou results.

In terms of contributing to the overall herpetological species richness, the pitfall trapping efforts were of limited success. Seven amphibian species and one reptile, *Kinixys erosa*, were captured in pitfalls (Table 3). Of these, only *Hemisus perreti* was not recorded by means of opportunistic searches. The pitfalls were, however, efficient in terms of capturing good series of species that were otherwise rarely encountered opportunistically—more than 95% of *Xenopus epitropicalis* and about 90% of *Geotrypetes seraphini* specimens were from pitfall captures. We are puzzled by the paucity of reptile captures by these traps, particularly since the pitfall line set at the Université de Rennes Camp (site 5) collected four specimens comprising three skink species, i.e., *Mabuya affinis*, *M. polytropis*, and *Leptosiaphos breviceps*.

The species data obtained from localities other than the elevational transect (Camps 1, 2 and 3) account for 35.1% of the total herpetofaunal richness recorded during this survey (excluding the eight reptile species sampled afterwards). In comparison with the three camps, collecting effort at these sites was much less and thus we expect that the overall species richness figure for Monts Doudou would be increased substantially by increased survey efforts. Reptiles in particular were poorly represented in our survey (24 species and another eight subsequently) and we believe the real richness may be double that currently recorded. Using the combined results of all sampling techniques, the trend of the amphibian species accumulation curves (Fig. 1) suggest that continued effort at Camps 1 and 2 would probably have increased the species richness for these sites. The curve for Camp 3, however, flattened off comparatively sooner and an extended sampling effort here will presumably less likely to be met with a concurrent increase in species richness.

Reptile records obtained during this survey are insufficient for any meaningful analyses of site partitioning (see Table 5). Comparisons of amphibian species turnover between the three camps show only moderate evidence of elevational effects (see Table 4 and Fig. 2). Richness figures were similar with 21 species from Camp 1, and 22 and 17 species from Camps 2 and 3, respectively. Of the 34 combined species recorded, Camp 1 was most different with eight unique species (38.1% uniqueness), six species were particular to Camp 2 (27.3% uniqueness) and only two were particular to Camp 3 (11.8% uniqueness). Camps 1 and 2 combined had 94.1% (32 of 34) of the recorded species. Camps 2 and 3 combined accounts for 76.5% (26 of 34) of the species, thus further demonstrating the relatively greater uniqueness of Camp 1 in the overall comparisons of the three camps. The coefficients of community, or similarity indices, are presented in Table 6. The highest coefficient (0.50) is between Camps 2 and 3. The "capture rate" of amphibians decreased sharply from the lowest elevation up to the highest, with overall rates of 74.6%, 20.4% and 8.2% at camps 1, 2, and 3, respectively.

The above results do not attest to a mid-altitude "bulge" that has been reported for herpetofaunal diversity in Madagascar (Raxworthy et al. 1998; Nussbaum et al. 1999), but they do partially support the trend of a herpetofaunal diversity decline at higher elevations (Raxworthy and Nussbaum 1996; Nussbaum et al. 1999). It must be noted, however, that the Monts Doudou elevational gradient is quite different from the Madagascar studies. At the Réserve Naturelle Intégrale d'Andringitra the transect was over an altitude range of 1650 m (i.e., 650–2300 m), at the Anjanaharibe-Sud Massif the range was 1200 m (800–2000 m) and at the Réserve Naturelle Intégrale d'Andohahela it was 1435 m (440–1875 m). The Monts Doudou elevational transect was of a much shorter range (550 m) and it commenced and terminated at lower altitudes (110–660 m).

TABLE 5. Details of reptilian species turnover between Camps 1, 2, and 3. The first column lists the cumulative 16 species recorded from all three camps. The next three columns reflect species occurrence at these camps, followed by species uniqueness (U) at each camp and species shared (=) between camps. The last two columns show combined (+) species richness of Camps 1 and 2, and Camps 2 and 3 respectively. Note that Camp 1 consists of study sites 4, 6, and 7; Camp 2 is site 8 and Camp 3 is site 9.

Species - Reptilia	1	2	3	U1	U2	U3	1=2	1=3	2=3	1+2	2+3
Atheris squamigera		1			1					1	1
Boiga pulverulenta	1			1						1	
Calabaria reinhardtii			1			1					1
Crotaphopeltis hotamboeia	1			1						1	
Dipsadoboa duchesnii			1			1					1
Feylinia grandisquamis	1	1					1			1	1
Hemidactylus fasciatus	1	1	1					1	1	1	1
Hemidactylus muriceus	1			1						1	
Kinixys erosa		1	1						1	1	1
Leptosiaphos breviceps		1			1					1	1
Mabuya affinis	1			1						1	
Mabuya polytropis	1	1					1			1	1
Naja cf. melanoleuca	1			1						1	
Natriciteres fuliginoides		1			1					1	1
Philothamnus sp. 1	1			1						1	
Rampholeon spectrum		1	1						1	1	1
TOTALS	9	8	5	6	3	2	2	1	3	14	10

With the above in mind, an elevational analyses of herpetofaunal diversity at Monts Doudou should best be conducted following some further intensive surveys, since species turnover along such a short altitudinal range is likely to be less pronounced and would require a larger data set to be measured effectively. In a number of cases our data did show some strong evidence of species turnover, the best examples being 53 specimens of *Hemisus perreti* at Camp 1 and none further up; 120 specimens of *Xenopus epitropicalis* at Camp 1, 18 specimens at Camp 2 and none at Camp 3; 11 specimens of *Phrynobatrachus auritus* at site 5 and Camp 1, but none further up; about 15 observations of *Astylosternus batesi* at Camp 3 and none further down. However, there are also some instances that, at first glance, may be interpreted as a marked elevational partitioning when in fact this may not be the case. For example, four specimens of *Arthroleptis variabilis* were recorded from Camp 3 and none from the lower two camps. Yet a single specimen of this species was collected at site 5 which is located less than 1 km from Camp 1 at the same altitude. The main problem with our data set is that it includes numerous species for which only small numbers were collected or observed, e.g., *Trichobatrachus robustus* (1 specimen), *Alexteroon obstetricans* (1), *Xenopus fraseri* (1), *Bufo tuberosus* (2), *Nectophryne batesii* (2), *Leptopelis rufus* (2) and *Petropedetes* sp. 1 (3). The current faunal compositions of the various camps could easily have been very different were these species not recorded in a particular camp or if they were also recorded from further camps. Examples of species only re-

TABLE 6. Coefficients of community (C) (above diagonal) and number of species shared (below diagonal) between four of the localities sampled at Monts Doudou. C = number of shared species divided by the total number of species of the two locatlities being compared.

	Site 3	Camp 1	Camp 2	Camp 3
Site 3 (110 m)	–	0.03	0	0
Camp 1 (110 m)	1	–	0.34	0.36
Camp 2 (350–425 m)	0	11	–	0.50
Camp 3 (585–660 m)	0	10	13	–

corded at mid-altitude (Camp 2) should also be regarded as being non-conclusive (e.g., *Chiromantis rufescens* and *Scotobleps gabonicus*).

Apart from some of the elevational differences that we have highlighted, the current limited data set for Monts Doudou also shows evidence of greater variation between sites situated at the same altitude. The measures of uniqueness that we already presented above for Camps 1 to 3 were 38.1%, 27.3%, and 11.8%. If site 3 is compared with Camp 1, they have a very low similarity index of 0.03 (Table 6), and high uniqueness values of 92.3% and 95.2% respectively. These sites are about 7 km apart, both are in forest habitat, but the wetland types are very different—standing marshes at site 3 versus a flowing stream at Camp 1. Although sampling effort at site 3 was only about 12 hours during two nights, we did not lump the data from here with that of Camp 1 since this would have introduced a sampling bias and hindered comparisons between the three elevational camps. The main point to consider here is that only one of the 13 species recorded at site 3 was also recorded at Camp 1. Thus it seems likely that habitat heterogeneity within a particular altitude may in fact be more influential as a determinant of amphibian communities. Hofer and colleagues (2000) studied the effects of ecotones and elevational gradients (900–2000 m) on herpetological communities in the primary forest of Mount Kupe, Cameroon. They recorded significant relationships with the elevational gradient for both reptile and amphibian communities. However, frogs also showed a response to ecotones, especially in respect to presence or absence of watercourses.

Considering that 72 amphibian species are known from Gabon (Frétey and Blanc 2000), the current Monts Doudou total of 54 is a relatively high proportional richness for a single locality. In comparison for example, Frétey and Dewynter (1998) recorded 38 anuran species from the Forêt des Abeilles, Gabon, and Largen and Dowsett-Lemaire (1991) recorded 39 anurans from the Kouilou River Basin in the Congo. But we believe that these are still early days for herpetological assessments in Gabon. The two independent surveys conducted in Gabon during January to March 2000 pushed the country's total up to 84 species. The first study (Lötters et al. 2000; Lötters et al. 2001) discovered six species new for Gabon. Our study found two of those species and another six species new for Gabon and eleven unidentified species. The latter may include undescribed species, or recognized species new for Gabon, or species already known from Gabon. Thus it is not inconceivable that the real total for Gabon may in fact exceed 100 species. Future surveys of Monts Doudou amphibians are likely to add many more species to the current total of 54, particularly if a mixture of habitat types were to be surveyed. A case in point is the fact that the last four species added to the Monts Doudou total were recorded in savanna on the last night as the survey drew to an end.

The Monts Doudou material includes amphibian genera (*Hemisus* and *Kassina*) that are first-time records for Gabon. Likewise the genera *Hoplobatrachus* and *Trichobatrachus*

are also new for Gabon, having been recorded during our survey and also by Lötters et al. (2001). Amphibian genera known to occur in Gabon, but which were not recorded during our survey are *Aubria*, *Chlorolius*, *Cryptothylax*, *Herpele*, *Hymenochirus*, *Leptodactylodon*, and *Opisthothylax* (Frétey and Blanc 2000).

Although this survey has contributed substantially towards the herpetofaunal knowledge of Monts Doudou and Gabon in general, the results also clearly show that much more is still to be learned about the amphibians and reptiles of Gabon. The current impoverished knowledge is not only in terms of inadequacies in alpha-level taxonomy, species lists, and zoogeographic analyses, it is especially acute with respect to basic information regarding life history and ecology of the Gabonese herpetofauna. The opportunities and tasks ahead are ample and would require much greater effort than the once-off, rapid-assessment approach that we used. The only sure way in which to achieve this is by means of local expertise capacity building. Lawson and Klemens (2001) believe that the amphibian species richness disparity between comparable African and Neotropical countries is not necessarily because of a real higher faunal diversity of the latter. Instead they make a case that the higher diversity is correlated with increased research efforts which commenced in the 1960s. The development of national scientific capacity over the successive 40 years gave rise to an unprecedented increase in species descriptions of Colombian and Ecuadorian amphibians. They also make the point that the alpha-level taxonomy of African amphibians and reptiles is still rudimentary and thus there exists considerable scope for new species discoveries and descriptions if a generation of national biologists were to be trained. The current onslaught on the natural environment from timber exploitation, increased agriculture, and mining is starting to reach alarming proportions, thus making the development of relevant national expertise in central African countries a matter of extreme urgency.

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